

Pedestrian foot traffic disturbs ovipositing Karner blue butterflies: Potential implications for trail construction



Vanessa S. Quinn, Victoria Bennett,
and Patrick A. Zollner

Using virtual ecology to investigate impacts of recreation upon wildlife



Motivation for investigating the effects of ecotourism and recreation

❖ Potential Implications

- Positive
 - Increased revenue
 - Increased public awareness/appreciation
 - Increased support for wildlife preservation



Research Question

- Will trail use in proximity to Karner blue butterflies influence behavior and host plant selection?

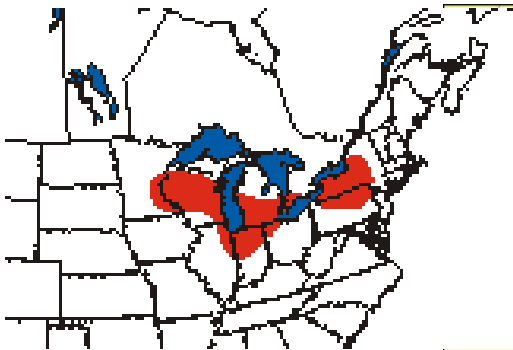




- Karner Blue Butterfly
(*Lycaeides melissa samuelis*)
 - Small butterfly with a wingspan of about 2.5 cm
 - Sexually dimorphic
- Two generations of this butterfly occur each year.
 - Late April
 - Early Summer (July)
- Feeding behavior
 - Adult butterflies nectar on flowering plants
 - Caterpillars feed only on wild lupine.

Conservation Status

- Endangered species found in only a few areas of mid-western North America.



Simulation of Disturbance Activities (SODA)

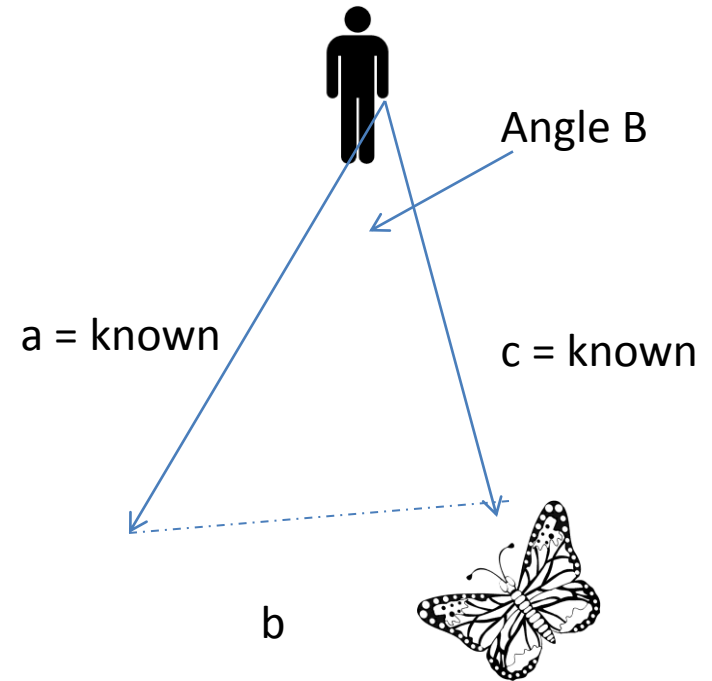
- Flexible for modeling multiple species
- Stochastic individual-based model
- Uses realistic case study maps
- Puts emphasis on species responses
 - Behavioral not population level responses
 - Simultaneous responses to multiple human disturbance types
- Diverse scenario capabilities

Three inputs for SODA

- Wildlife Inputs
 - Activity and behavioral patterns
 - Predation risk
 - Movement rules*
 - Responses to human activity**
 - Flight initiation distance – recreationalist causes wildlife to flee
 - Fleeing distance – how far the wildlife goes
 - Time spent latent – how long before the wildlife returns
 - Detection distance – wildlife detect a recreationalist

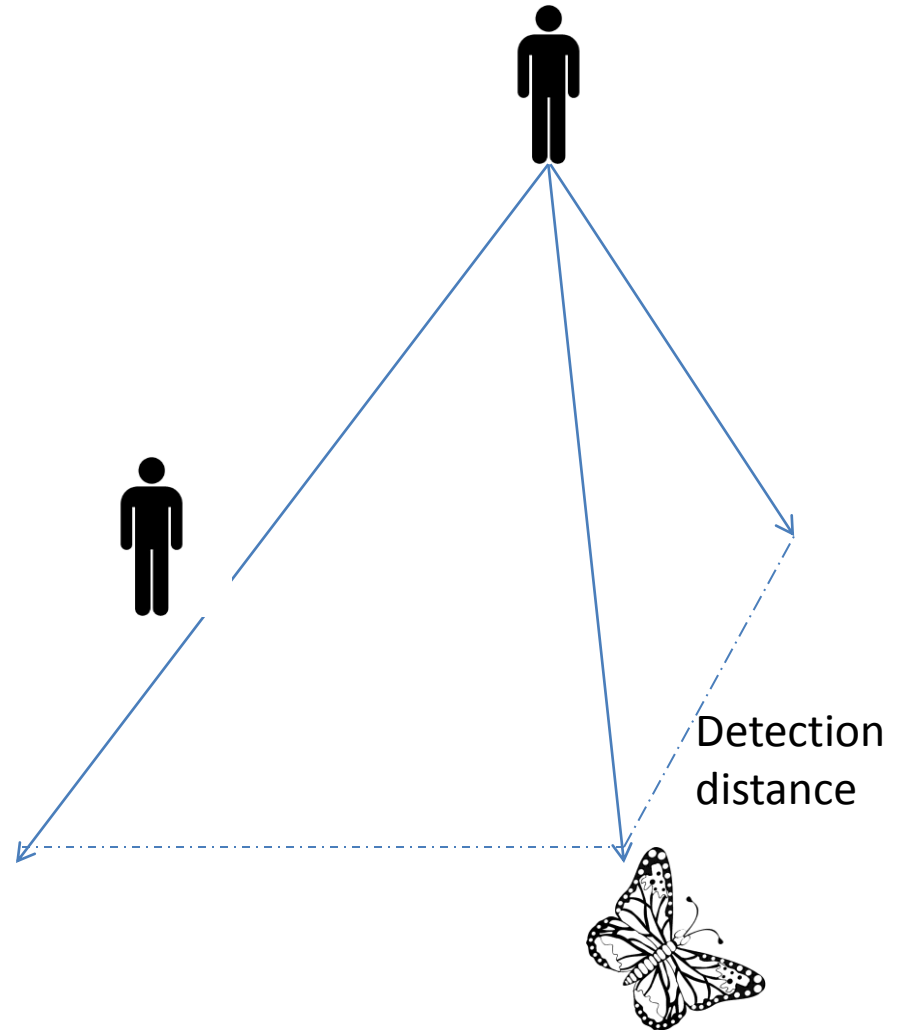
Movement rules

- Observe male and female butterflies
 - Estimate first distance to butterfly (c)
 - Estimate first bearing of butterfly (Bearing 1)
- Butterfly moves
 - Distance 2 (a)
 - Bearing 2
- Calculate the flight distance (b) using simple trigonometry
 - Angle B = Bearing 1 - Bearing 2
 - $b^2 = a^2 + c^2 - 2ac(\cos B)$



Responses to Human Activity

- Observe male and female butterflies
 - D1
 - Bearing 1
- Recreationalist moves
 - Distance 2 to pedestrian
 - Bearing 2 to pedestrian
- Butterfly moves
 - Distance 3 to butterfly
 - Bearing 3 to butterfly



One example of wildlife input

- Female flight distance was significantly greater when disturbed by a pedestrian ($207 \text{ cm} \pm 52.8$) than when there was no pedestrian present ($125 \text{ cm} \pm 32.1$; $t = 2.587$; $P = 0.006$)
- There is no difference in male flight distance in the presence ($257 \text{ cm} \pm 152.6$) or absence of a predator ($348 \text{ cm} \pm 97.6$; $t = 1.032$; $P = 0.315$)

Three inputs for SODA

- Scenario inputs
 - Number of days a simulation is run
 - Season length during oviposition
 - GIS map of the study site with specific features
 - Trails
 - Every 20 steps
 - GPS location
 - Distance to nearest lupine plant



Three inputs for SODA

- Anthropogenic Inputs
 - Types of recreation observed
 - Hikers alone and in groups
 - Dog walkers on and off leash
 - Temporal patterns of activity
 - Time of day
 - Day of the week
 - Length of use
 - Frequency of use

SODA Output

- Frequency of disturbance over 16 days
 - How does visitor number affect butterfly disturbance?
 - Visitor numbers significantly affected disturbance rates.
 - During periods of maximum visitation approximately 50% more disturbance-related behaviour was exhibited compared to intermediate or minimum scenarios.

SODA Output

- Frequency of disturbance over 16 days
 - How does habitat (wild lupine patches) affect butterfly disturbance?
 - Sensitive and tolerant individuals
 - Females more sensitive than males
 - Habitat matters
 - Virtual butterflies in habitat patches extending 10 to 15 m from the trail experienced 40% more disturbance than those in habitat patches exceeding 20 m.

Future Research

Isolated
Rare
Specialists



Karner Blue
L. melissa samuelis



American Copper
Lycaena phlaeas

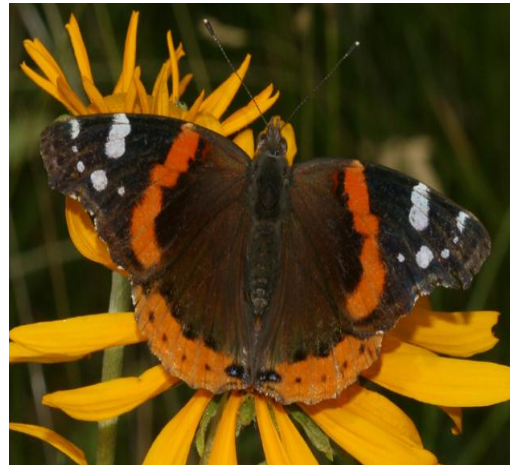


Olympic Marble
Euchloe olympia

Widespread
Common
Generalist



Little Wood Satyr
Megisto cymela



Red Admiral
Vanessa atalanta



Spring Azure
Celastrina ladon

Acknowledgements

- Indiana Academy of Science
- Indiana-Illinois Sea Seed Grant
- Indiana Dunes
- Dr. Randy Knutson